FLOW IN A PIPELINE WITH LEAKAGE

SITI NUR HASEELA BINTI IZANI

A dissertation submitted in partial fulfillment of the
requirement for the award of the degree of
Master of Science (Engineering Mathematics)

Faculty of Science
Universiti Teknologi Malaysia

JANUARY 2013

To my beloved Ma and Abah, my lovely Kak Long; my cute little brothers and sisters and my bestfriend, NurFara Azrin. Thanks for all their love and understanding.

And Thanks to Allah for guiding my ways.

ACKNOWLEDGEMENT

In the name of Allah, the most Beneficent, the most Merciful.

Alhamdulillah, all praises to Allah. Thanks to Allah for giving me the opportunity and the strength to fulfill my dissertation after all the challenges and difficulties.

First and foremost, I am deeply grateful to my supervisor, Dr. Anati Bt Ali for her guidance, advices and motivation in conducting this dissertation. I consider myself very fortunate for being able to work with a very considerate and dedication lecturer like her. I am gratefully thankful for her encouragement. I also indebted grateful to Prof. Norsarahaida Bt S.Amin and Prof Mohd Nor for giving me some suggestions, criticisms and constructive comment.

I would like to extent my gratitude to my supportive family who always support me in my journey of education. Thanks to mum, dad and siblings for your taking care of me in every way possible and for being there for me when I was exhausted to believe in myself. Thanks you for pushing me.

Last but not least, I would like to thank to all my beloved friends for their willingness to support and help me to ensuring the completion of this dissertation.

Once again, thanks to Allah for guiding my ways. Alhamdulillah.

ABSTRACT

Leakage in pipelines has always been one of the main problems in pipelines transportation fluid. This fluid leakage can happened without any warning. The leaking of fluid in pipeline can give effects to the economic loss and environmental risk. Therefore, the early detection of leak is a main role in the fluid transportation pipelines. This paper presents a technique for early detection of leak in single pipe. The fluid pressure and flow rate velocity are considered as two dependent variables. The governing equations of transient flow were proposed. The mathematical formulation describes the solution process and then solved by the Method of Characteristics and Finite Different Method (FDM). The simulation of pipeline leakage with the three different diameters has been carried out by Matlab programming to see the behavior of pressure and flow in the upstream head and downstream head when leakage occurs. The results show; flow rate trends at the incoming fluid flow pipelines is not equal to outgoing fluid pipelines when leaking occurs and pressure trend at the incoming fluid also not equal to pressure trend outgoing fluid. These situations are obtained to indicate the early presence of leakage. This method provided a theoretical basis for early recognizing leakage.

ABSTRAK

Kebocoran paip sentiasa menjadi satu masalah utama dalam bidang pengangkutan bendalir melalui paip. Kebocoran bendalir ini boleh berlaku tanpa sebarang amaran. Kebocoran bendalir di dalam sistem paip ini boleh memberi kesan kepada kerugian besar terhadap ekonomi negara dan juga memberi risiko terhadap alam sekitar. Oleh itu, pengesanan di peringkat awal kebocoran memainkan peranan yang penting dalam bidang pengangkutan bendalir melalui paip ini. Kertas ini membentangkan satu teknik untuk mengesan kebocoran di peringkat awal kebocoran dalam paip tunggal. Tekanan bendalir dan kadar aliran halaju dianggap sebagai dua pembolehubah bersandar. Persamaan asas aliran fana diperkenalkan. formulasi matematik menerangkan teknik penyelesaian dan kemudian diselesaikan oleh kaedah ciri-ciri dan kaedah beza terhingga. Dengan menggunakan pengaturcaraan Matlab, simulasi kebocoran di saluran tiga paip yang berbeza diameter telah diuji untuk melihat bentuk tingkah laku tekanan dan aliran di awal takungan dan di akhir takungan apabila kebocoran paip berlaku. Keputusan menunjukkan apabila wujudnya kebocoran pada sesuatu paip, trend kadar aliran pada awal aliran bendalir masuk tidak sama dengan akhir aliran bendalir keluar dan begitu juga dengan trend tekanan bendalir. Situasi sebegini menunjukkan bahawa kebocoran di dalam paip boleh dikesan pada peringkat awal. Kaedah ini hanya menghasilkan satu asas teori untuk mengesan dan mengenalpasti kebocoran.